CHAPTER

TRANSPORT

MULTIPLE CHOICE QUESTIONS

1. **The outermost layer of the root:**
   (a) Endodermis (b) Cortex (c) Pericycle (d) Epidermis
2. **Roughly how much of water that enters a plant is lost via transpiration?**
   (a) 50% (b) 70% (c) 80% (d) 90%
3. **If humidity increases, then rate of transpiration:**
   (a) Increases (b) Decreases (c) Remains constant (d) None of these
4. **The parts of plant of active metabolism or storage:**
   (a) Sources (b) Sinks (c) Both a & b (d) None of these
5. Percentage of plasma in blood:
   (a) 35% (b) 45% (c) 55% (d) 65%
6. **Percentage of cells or cell like bodies in blood:**
   (a) 35% (b) 45% (c) 55% (d) 65%
7. **Blood clotting protein:**
   (a) Fibrinogen (b) Pepsin (c) Pepsinogen (d) Albumin
8. **Average life span of erythrocytes:**
   (a) 100 days (b) 110 days (c) 120 days (d) 130 days
9. **Which one is a agranulocyte?**
   (a) Monocyte (b) Basophil (c) Neutrophil (d) Eosinophil
10. **Average life span of platelets:**
    (a) 4 to 5 days (b) 5 to 6 days (c) 6 to 7 days (d) 7 to 8 days
11. **Uncontrolled production of defective white blood cells:**
    (a) Thalassaemia (b) Leukaemia (c) Atherosclerosis (d) Infarction
12. **The world celebrates the International Thalassaemia Day on:**
    (a) 6^{th} of May (b) 7^{th} of May (c) 8^{th} of May (d) 9^{th} of May
13. **Total number of blood group systems recognized by the International Society of Blood Transfusion:**
    (a) 25 (b) 27 (c) 29 (d) 31
14. **The person having blood group B can donate blood to:**
    (a) O and A (b) O and AB (c) B and AB (d) A and B
15. **The person having blood group O can receive from:**
    (a) A (b) B (c) AB (d) O
16. **The alternating contraction and relaxation of heart chambers:**
    (a) Systole (b) Diastole (c) Cardiac cycle (d) Pulse rate
17. **Average human heart beat per minute:**
    (a) 60 (b) 70 (c) 80 (d) 90

18. Who first described the pathway of blood circulation:
(a) Ibn-e-Nafees (b) William Harvey (c) Rudolf Virchow (d) Louis Pasteur

ANSWERS:

1	d	2	d	3	b	4	b	5	c
6	b	7	a	8	c	9	a	10	d
11	b	12	c	13	c	14	c	15	d
16	c	17	b	18	a				

SHORT QUESTIONS

Q. No. 1 Why the cells are regarded as units of life?

CELLS AS UNITS OF LIFE

Cells are the primary sites for metabolic processes. That is why they are regarded as the 'units of life'.

Q. No. 2 Why materials are transported to and from cells?

NEED OF TRANSPORT

Complex metabolic reactions occur in living organisms. In order to run their metabolism, cells need some materials from the environment and also need to place some materials into the environment. For this purpose, materials are transported to and from cells.

Q. No. 3 What is the limitation of phenomenon of diffusion for transport?

LIMITATION OF DIFFUSION AS A WAY OF TRANSPORT

The diffusion can not fulfill the need the complete needs of transport because it takes much time for materials in a solution to diffuse even a few inches.

Q. No. 4 Why diffusion can work efficiently in unicellular and simple multicellular organisms?

DIFFUSION IN UNICELLULAR AND SIMPLE MULTICELLULAR ORGANISMS

Diffusion can work only in unicellular and simple multicellular organisms because every corner of their body is in close and direct contact with the environment.

Q. No. 5 Why diffusion can not work efficiently in complex multicellular organisms?

DIFFUSION IN COMPLEX MULTICELLULAR ORGANISMS

In complex multicellular bodies, cells are far apart from the environment and such bodies need a comprehensive system for the transport of materials.

Q. No. 6 How is plasma separated from blood?

SEPARATION OF PLASMA FROM BLOOD

Blood is taken from an artery and an anti-coagulant (a chemical that inhibits blood clotting) is mixed in it. After about 5 minutes, plasma separates from blood cells, which settle down.

Q. No. 7 Give an example that plants need a lot of water.

NEED OF WATER BY PLANTS

Plants need a lot of water. Young *Brassica* plants take up an amount of water equal to their shoot weight in about 5 hours. If that applied to us, we would have to drink 3 gallons of water an hour to stay alive.

Q. No. 8 What is the effect of water stress in plants?

WATER STRESS IN PLANTS

There is strong evidence that even mild water stress results in reduced growth rate in plants.

Q. No. 9 According to the pressure-flow hypothesis what is the actual force behind the movement of food in phloem?

Drop in the pressure at sink end.

Q. No. 10 Which systems perform transport in humans?

TRANSPORT IN HUMANS

Transport of different materials in human body is performed by two systems.

- Blood circulatory system (Cardiovascular System)
- Lymphatic System

The two systems are well coordinated and associated with each other.

Q. No. 11 What is a closed circulatory system?

CLOSED CIRCULATORY SYSTEM

Definition:

It is a type of circulatory system in which the blood always remains in the blood vessels.

Examples:

Humans and other vertebrates.

Q. No. 12 What is an open circulatory system?

OPEN CIRCULATORY SYSTEM

Definition:

It is a type of circulatory system in which blood does not remain in the blood vessels.

Example:

Invertebrates like arthropods.

Q. No. 13 What are the main components of human blood circulatory system?

MAIN COMPONENTS OF HUMAN BLOOD CIRCULATORY SYSTEM

The main components of human blood circulatory system are:

- Blood
- Heart
- Blood vessels

Q. No. 14 How pus is formed?

FORMATION OF PUS

White blood cells die in the process of killing the germs. These dead cells accumulate and make the white substance called pus seen at the infection site.

Q. No. 15 What happens in dengue fever?

DENGUE FEVER

In dengue fever, there is a sharp decrease in the number of platelets in blood. Because of this, patients bleed from the nose, gums and under the skin.

Q. No. 16 Which blood cells are the most numerous in healthy human blood?

Red Blood Cells

Q. No. 17 What is the incidence of thalassaemia in the world?

INCIDENCE OF THALASSAEMIA

There are about 60-80 million people in the world who carry thalassaemia. India, Pakistan, and Iran are seeing a large increase in thalassaemia patients. Pakistan alone has 250,000 such patients. These patients require blood transfusions for life-time.

Q. No. 18 On what date International Thalassaemia day is celebrated? What is its aim?

INTERNATIONAL THALASSAEMIA DAY

The world celebrates the International Thalassaemia Day on 8th of May. This day is dedicated to raise public awareness about thalassaemia and to highlight the importance of the care for thalassaemia patients.

Q. No. 19 What is an antigen?

ANTIGEN

A substance which stimulates the production of an antibody when introduced into the body, i.e. it can stimulate an immune response.

Q. No. 20 What is an antibody?

ANTIBODY

An antibody is a protein found in blood which attacks and destroys invaders like bacteria and viruses.

Q. No. 21 What is the basis of blood group systems?

BASIS OF BLOOD GROUP SYSTEMS

Blood group systems are a classification of blood based on the presence or absence of antigens on the surface of red blood cells.

Q. No. 22 How many human blood groups systems have been studied till to date?

TOTAL NUMBER OF BLOOD GROUP SYSTEMS

A total of 29 human blood group systems are now recognized by the International Society of Blood Transfusion (ISBT).

Q. No. 23 Why the blood of donor should be checked before transfusion?

CHECKING OF DONOR'S BLOOD

A number of infectious diseases such as AIDS, Hepatitis B and C etc. can pass from the affected donor to the recipient. Before transfusion, the blood of donor is checked for germs etc.

Q. No. 24 Why heart is felt to be present on left side of our body?

FEELING OF PRESENCE OF HEART ON LEFT SIDE

The heart is usually felt to be on the left side because the left chamber of the heart i.e. left ventricle is stronger and has a thicker wall. It pumps blood to all body parts.

Q. No. 25 What is the mass and size of heart in normal adults?

MASS AND SIZE OF THE HEART

In normal adults, the mass of the heart is about 250-350 grams, and its size is equal to a clenched fist.

Q. No. 26 Why the walls of the left ventricle are the thickest one?

THICKEST WALLS OF LEFT VENTRICLE

The walls of the left ventricle are the thickest one. These are about a half inch thick. They have enough force to push blood into the body. This gives an evidence that the structures of the parts of heart are adaptive to their function.

Q. No. 27 What is the average human heartbeat?

AVERAGE HEARTBEAT

The average human heart beats 70 times/minute. So it would beat approximately 2.5 billion times during a life time of 66 years.

Q. No. 28 What is the percentage of adult deaths by cardiovascular disorders in Pakistan?

DEATHS BY CARDIOVASCULAR DISORDERS

According to the survey of Federal Bureau of Statistics of Pakistan, cardiovascular disorders were reported as the cause of 12% of the adult deaths in Pakistan.

Q. No. 29 What is the most common cause of cardiovascular disorders in Pakistan?

COMMON CAUSE OF CARDIOVASCULAR DISORDERS

The most common cause of cardiovascular disorders in Pakistan is hypertension (blood pressure higher than normal)

- There are over 12 million hypertensive patients in Pakistan.

Q. No. 30 What percentage of our population is diabetic?

PERCENTAGE OF DIABETIC POPULATION

About 10% of our population is diabetic.

Q. No. 31 What is the ratio of obese population in Pakistan?

OBESITY IN PAKISTAN

According to World Health Organization, in Pakistan, 1 in 7 urban adults is obese.

Q. No. 32 What is vascular surgery?

VASCULAR SURGERY

Definition:

The field in surgery in which diseases of arteries and veins are managed by surgical methods is called vascular surgery.

Example: Thrombosis

Vascular Surgeon:

A vascular surgeon treats diseases of all parts of blood circulatory system except that of heart and brain.

Q. No. 33 Through which blood vessels are the materials exchanged between blood and surrounding tissues?

Capillaries

Q. No. 34 Through which blood vessel, the oxygenated blood leaves human heart?

The oxygenated blood leaves human heart through a big blood vessel called aorta.

Q. No. 35 Why Plants form beneficial relationships with bacteria and fungi?

PLANTS RELATIONSHIPS WITH BACTERIA AND FUNGI

Plants form beneficial relationships with soil bacteria and fungi in order to increase absorption of minerals.

Q. No. 36 What is the contribution of Ibn-e-Nafees in the study of human blood circulatory system?

CONTRIBUTION OF IBN-E-NAFEES

Period:

1210-1286 AD

Specialty:

He was a physician.

Contribution:

He is honored to be the first scientist who described the path way of blood circulation.

Q. No. 37 What is the contribution of William Harvey in the study of human blood circulatory system?

CONTRIBUTION OF WILLIAM HARVEY

Period:

1578-1657 AD

Contribution:

He discovered the pumping action of heart and the pathway of blood in major arteries and veins.

Q. No. 38 What is the relationship between the concentration of solute and water potential?

RELATIONSHIP B/W CONCENTRATION OF SOLUTE AND WATER POTENTIAL

Water always moves from an area of higher water potential to an area of lower water potential. The relationship between the concentration of solute and water potential is inverse. When there is a lot of solute (i.e. hypertonic solution), the water potential is low and vice versa.

Q. No. 39 What are megakaryocytes?

MEGAKARYOCYTES

The fragments of large cells of bone marrow are called megakaryocytes. Theys forms the platelets.

LONG QUESTIONS

Q. No. 1 Write a note on water and ion uptake in plants.

WATER & ION UPTAKE

Functions of Roots:

- These anchor the plant.
- These absorb water and salts from soil.
- These provide conducting tissues for distributing these substances to the tissues of stem.

INTERNAL STRUCTURE OF ROOT

1. **Vascular Tissues:**
   The conducting tissues (xylem and phloem) of the root are grouped in the centre to form a rod-shaped core. This rod extends throughout the length of the root.
2. **Pericycle**
   Outside the conducting tissues, there is a narrow layer of thin-walled cells, the pericycle.
3. **Endodermis**
   A single layer of cells called endodermis surrounds the pericycle.
4. **Cortex**
   External to endodermis, there ia a broad zone of cortex. It consists of large and thin-walled cells.

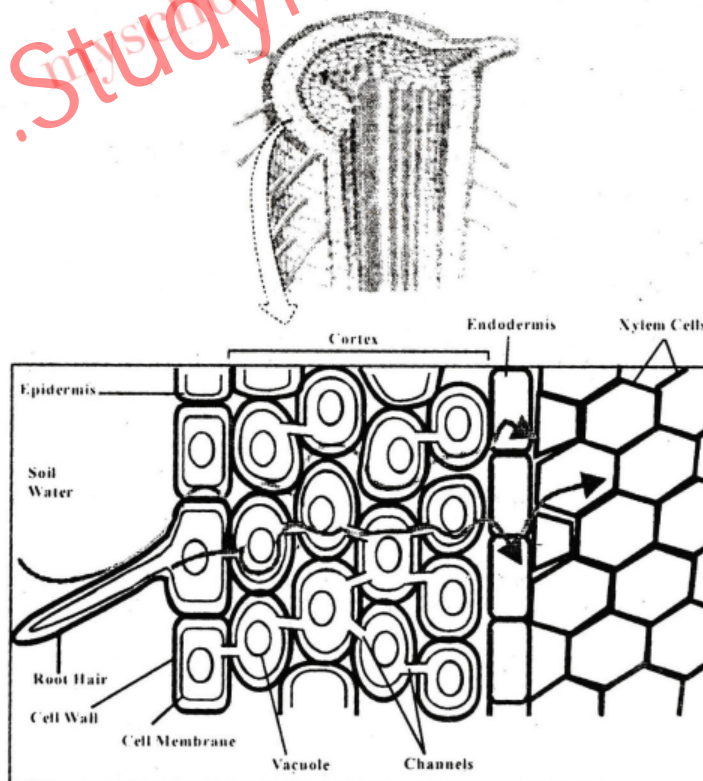



Figure: Uptake of Water and Ions by Root

5. **Epidermis**
   The cortex is bounded on outside by a single layer of epidermal cells.
6. **Root Hairs**
   Roots have clusters of tiny root hairs. These are actually the extensions of epidermal cells.

   Function: Root hairs provide a large surface area for absorption. They grow out into the spaces between soil particles where they are in direct contact with water.

MECHANISM OF TRANSPORTATION

Movement of Water into Root Hairs:

The cytoplasm of root hairs has higher concentration of salts than the soil water, so water moves by osmosis into the root hairs.

Movement of Salts into Root Hairs:

Salts enter root hairs by diffusion or active transport.

Entry into Xylem Tissues:

After their entry into the root hairs, water and salts travel through intercellular spaces or through cells (via channels, called plasmodesmata) and reach xylem tissue. Once in xylem, water ans salts are carried to all the arial parts of plant.

Q. No. 2 Write a note on transpiration.

TRANSPIRATION

Definition:

The loss of water from plant surface through evaporation is called transpiration.

Types of Transpiration:

There are three types of transpiration:

i. Stomatal transpiration
ii. Cuticular transpiration
iii. Lenticular transpiration

i. **Stomatal Transpiration:**
   Most of the transpiration occurs through stomata of the leaves and is called stomatal transpiration.

   Mechanism

- The mesophyll cells of leaf provide large surface area for the evaporation of water.
- Water is drawn from xylem into mesophyll cells, from where it comes out and makes a water film on the cell walls of mesophyll cell.
- From here, water evaporates into air spaces of the leaf.
- Water vapours then diffuse from air spaces towards the stomata and then pass to outside air.

ii. **Cuticular Transpiration:**
   The transpiration which is through the cuticle present on the leaf epidermis

iii. **Lenticular Transpiration:**
   The transpiration which is through special openings called lenticels present on the stems of some plants.

Quantity of Transpired Water:

Roughly 90% of the water that enters a plant is lost via transpiration.

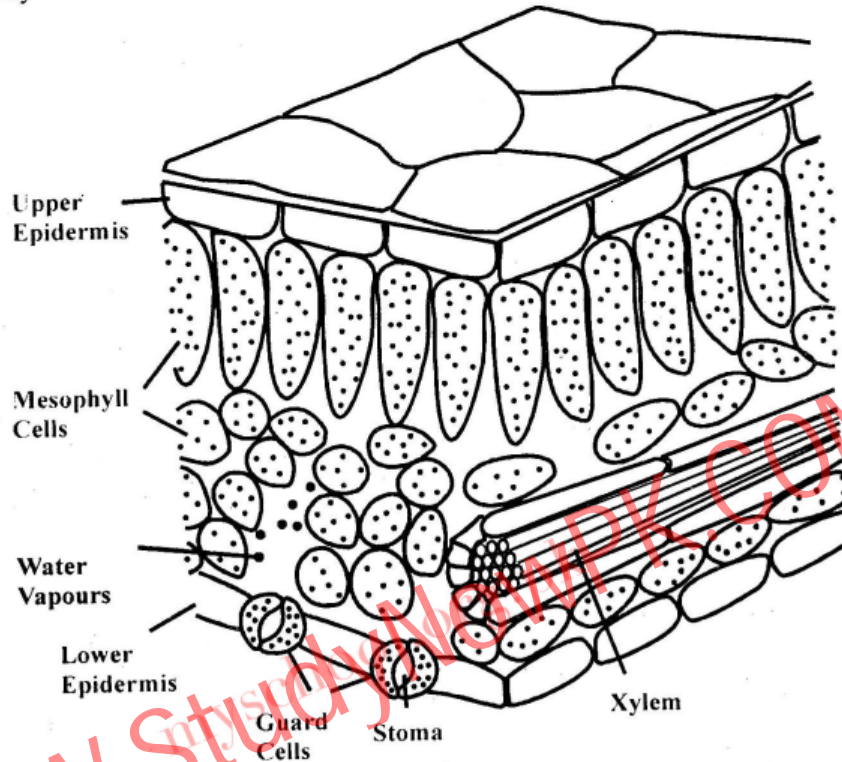



Figure: Events of Transpiration shown in the Section of a Leaf

Q. No. 3 Describe the mechanism of opening and closing of stomata.

OPENING AND CLOSING OF STOMATA

Structure of Stomata:

The two guard cells of a stoma are attached to each other at their ends. The inner concave sides of guard cells that enclose a stoma are thicker than the outer convex sides.

Function:

Stomata regulate transpiration by the action of guard cells.

Opening of Stomata:

When the guard cells get water and become turgid, their shapes are like two beans and the stoma between them opens.

Closing of Stomata:

When guard cells lose water and become flaccid, their inner sides touch each other and the stoma closes.

Role of Glucose:

The concentration of solutes (glucose) in guard cells is responsible for the opening and closing of stomata.

Role of Potassium Ions:

Recent studies have shown that stomata actually open and close due to the movement of Potassium ions in and out of guard cells.

During Daylight:

Light causes the movement of potassium ions from epidermal cells into guard cells. Water follows these ions and enters guard cells. Thus their turgidity increases and stoma opens. As the day progresses guard cells make glucose and become hypertonic. So water stays in them.

At Night:

At the end of the day, potassium ions flow back from guard cells to the epidermal cells and the concentration of glucose also falls. Due to it, water moves to epidermal cells and guard cells lose turgor. It causes closure of stomata.

Opening of Stomata at Night:

Some plants open their stomata at night when the overall water stress is low.

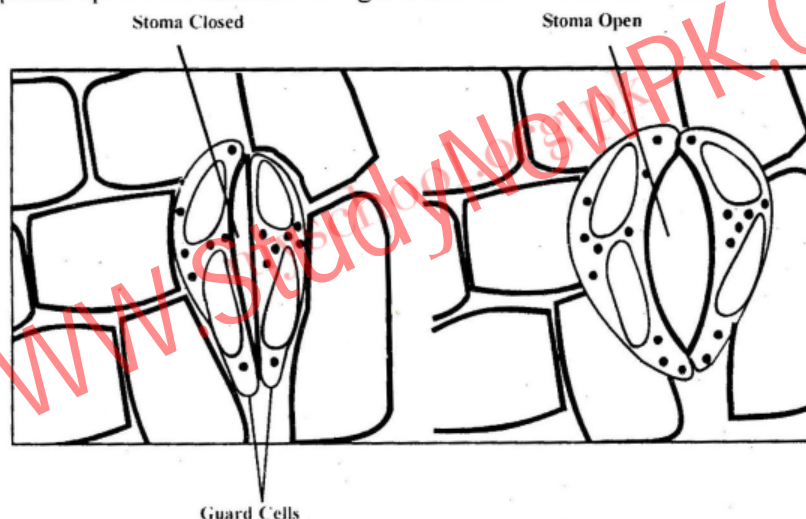



Figure: Opening and Closing of Stoma

Q. No. 4 Describe the factors affecting the rate of transpiration.

FACTORS AFFECTING RATE OF TRANSPIRATION

The factors which affect the rate of transpiration are as follows:

i. Light
ii. Temperature
iii. Humidity
iv. Wind
v. Leaf surface area

i. Light:

The rate of transpiration is directly controlled by the opening and closing of stomata and it is under the influence of light. In strong light the rate of transpiration is very high as compared to dim or no light.

ii. Temperature:

High temperature reduces the humidity of the surrounding air and also increases the kinetic energy of water molecules. In this way it increases the rate of transpiration. The rate of transpiration doubles with every 10 °C rise in temperature.

Very high temperature i.e. 40-45 °C causes closure of stomata, so transpiration stops and the plant does not lose much needed water.

iii. Humidity:

Less Humidity: When air is dry, water vapours diffuse more quickly from the surface of mesophyll cells into leaf air spaces and then from air spaces to outside. This increases in the rate of transpiration.

High Humidity: In humid air, the rate of diffusion of water vapours is reduced and the rate of transpiration is low.

iv. Wind:

Wind (air in motion) carries the evaporated water from leaves and it causes an increase in the rate of evaporation from the surfaces of mesophyll. When air is still, the rate of transpiration is reduced.

v. Leaf Surface Area:

The rate of transpiration also depends upon the surface area of the leaf. More surface area provides more stomata and there is more transpiration.

Q. No. 5 Describe the significance of transpiration.

SIGNIFICANCE OF TRANSPIRATION

Necessary Evil:

Transpiration is called a necessary evil. It means that transpiration is a potentially harmful process but is unavoidable too.

Harmful Aspect of Transpiration:

Transpiration may be a harmful process in the sense that during the conditions of drought, loss of water from plant results in:

- Serious desiccation
- Wilting
- Often death

Benefits of Transpiration:

On the other hand, transpiration is necessary too in the following ways:

Transpirational Pull:

It creates a pulling force called transpirational pull, which is principally responsible for the conduction of water and salts from roots to the aerial parts of plant body.

Cooling Effect:

When water transpires from the surfaces of plant, it leaves a cooling effect on plant. This is especially important in warmer environments.

Gaseous Exchange:

The wet surfaces of leaf cells allow gaseous exchange.

Q. No. 6 **Describe transport of water in plants.**

TRANSPORT OF WATER

Introduction:

The process by which water is raised to considerable heights in plants has been studied for years in botany. The result of this research is "Cohesion-Tension Theory".

COHESION-TENSION THEORY

Statement:

According to this theory, the force which carries water (and dissolved materials) upward through the xylem is transpirational pull. Transpiration creates a pressure difference that pulls water and salts up from roots.

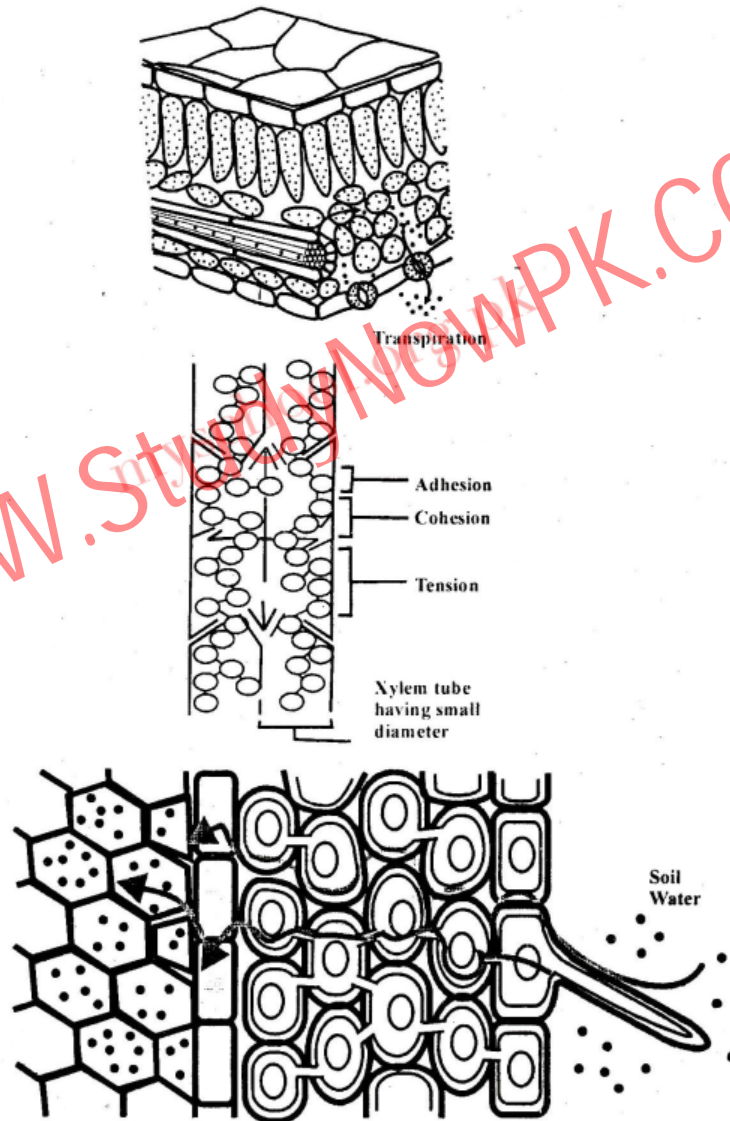



Figure: Transport of Water

Explanation:

When a leaf transpires (loses water), the water concentration of its mesophyll cells drops. This drop causes water to move by osmosis from the xylem of leaf into mesophyll cells. When one water molecule moves up in the xylem tissue of leaf, it creates a pulling force that continues all the way to the root. This pulling force created by the transpiration of water is called transpirational pull. It also causes water to move transversely, from root epidermis to cortex and pericycle.

Reasons for the Creation of Transpiration Pull:

Following are the reasons for the creation of transpiration pull:

i. **Xylem Diameter:**
   Water held in a tube (xylem) has a small diameter.

ii. **Adhesion:**
   Water molecules adhere to the walls of xylem tube, this phenomenon is called adhesion.

iii. **Cohesion:**
   Water molecules cohere to each other, this phenomenon is called cohesion.

Formation of Water Column:

These attractions make an over all tension among water molecules. This tension forms columns of water. The columns of water move from root to shoot and the water content of the soil enters in these columns.

Direction of Water:

Xylem is a one way street from the root to the leaves for water and salts.

Q. No. 7 Describe transport of food in plants.

TRANSPORT OF FOOD

Phloem:

Phloem is responsible for transporting food substance throughout plant body.

Conversion of Glucose into Sucrose:

The glucose formed during photosynthesis in mesophyll cells, is used in respiration and the excess of it is converted into sucrose. In most plants, the food is transported in the form of sucrose.

PRESSURE-FLOW MACHANISM

The movement of food in plants has been studied for years. The currently accepted hypothesis states that transport of food is through pressure-flow mechanism.

Statement:

In pressure-flow mechanism, the food is moved from sources to sinks.

Sources:

Sources include the exporting organs, typically:

- A mature leaf
- A storage organ

Sinks:

Sinks are areas of active metabolism or storage, such as:

- Roots
- Tubers
- Developing fruits and leaves
- Growing regions

Storage Organ:

A storage organ is capable of storing food and exporting the stored materials.

For example:

The root of beet is a sink in first growing season, but becomes source in the next growing season, when sugars are utilized in the growth of new shoots.

Explanation:

At the source end:

At source, food (sugars) is moved by active transport into the sieve tubes of phloem. Due to the presence of sugar in sieve-tubes, their solute concentration increases and water enters them from xylem via osmosis. This results in a higher pressure of water in these tubes, which drives the solution of food towards sink.

At the sink end:

The food is unloaded by active transport. Water also exits from the sieve tubes. The exit of water decreases pressure in sieve tubes, which causes a mass flow from the higher pressure at the source to the lowered pressure at the sink.

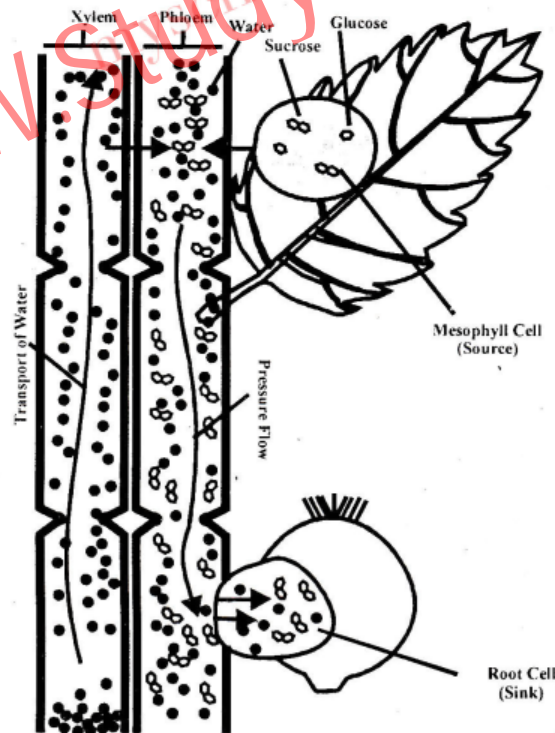



Figure: Transport of Food

Direction of Transport:

Xylem is a one way street from roots to leaves for water and salts. Phloem is a two way street for food. The direction of the movement of food is decided by demand and supply in sinks and sources.

Q. No. 8 Write a note on blood.

BLOOD

Blood is a specialized body fluid (a connective tissue) that is composed of:

- A liquid called Blood Plasma

  Volume of Plasma: Plasma constitutes about 55% by volume of blood.
- Blood Cells

  Volume of Cells: Cells or cell-like bodies constitute about 45% volume of the blood.

Weight:

The weight of blood in our body is about 1/12th of our body.

Volume:

The average adult body has about five litres of blood.

Figure: Percentage Composition of Human Blood

BLOOD PLASMA

Dissolved Substances:

Plasma is mainly water in which the following are dissolved:

- Proteins
- Salts
- Ions
- Metabolites
- Wastes

Percentage Composition:

- Water constitutes about 90-92% of plasma.
- Dissolved substances constitute about 8-10% of plasma.

Salts:

Salts make up 0.9% of the plasma by weight. Sodium chloride (the table salt) and salts of bicarbonate are present in considerable amount.

Trace Elements:

The following trace elements are also found:

- Ca
- Mg
- Cu
- K
- Zn

pH:

Normal pH of blood is 7.4. Changes in the concentration of any salt can change the pH of blood.

Proteins:

Proteins make 7-9% by weight of plasma. The important proteins present in plasma are:

- Antibodies
- Fibrinogen (blood clotting protein)
- Albumin (maintains the water balance of blood)

Other Substances:

Plasma also contains:

- Digested food (absorbed from digestive system)
- Nitrogenous wastes
- Hormones
- Respiratory gases (CO_2 and O_2)

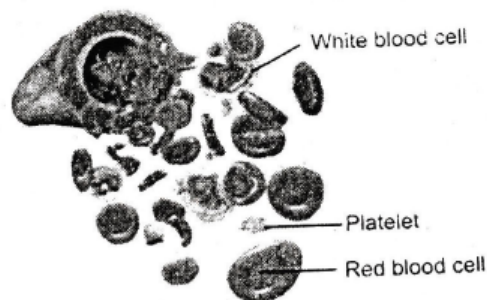



Figure: Different Cells and Cell-like Bodies in Blood Plasma

Pigment:

They have no pigment.

Number:

One cubic milliliter of blood contains 250,000 platelets.

Life Span:

The average life span of a blood platelet is about 7 to 8 days.

Function:

Platelets help in blood clotting. The clot serves as a temporary seal at the damaged area.

Decrease of Platelets in Dengue Fever:

In Dengue fever, there is a sharp decrease in number of platelets blood. Because of this, patients bleed from nose, gums and under the skin.

Q. No. 9 Write a note on blood disorders.

BLOOD DISORDERS

There are many types of blood disorders, including:

- Bleeding disorders
- Leukemia
- Thalassaemia

LEUKEMIA (Blood Cancer)

Introduction:

Leukemia is the production of a great number of immature and abnormal white blood cells.

Cause:

This is caused by a cancerous mutation (change in gene) in bone marrow or lymph tissue cells.

Effect:

The mutation results in an uncontrolled production of defective white blood cells (leukocytes).

Treatment:

It is a very serious disorder. The blood needs to be changed regularly with normal blood obtained fro donors.

Cure:

It can be cured by bone marrow transplant. It is effective in most cases, but very expensive treatment.

THALASSAEMIA

Meaning:

It is a Greek word.

- Thalassa means sea
- Haem means blood

Cooley's Anaemia:

It is also called Cooley's Anaemia on the name of Thomas B. Cooley, an American physician.

Cause:

It is a genetic problem due to mutations in the gene of haemoglobin.

Effect:

The mutation results in the production of defective haemoglobin and the patient cannot transport oxygen properly.

Treatment:

The blood of the patient is to be replaced regularly with normal blood.

Cure:

It can be cured by bone marrow transplant but it does not give 100% cure rate.

Incidence of Thalassaemia:

There are about 60-80 million people in the world who carry thalassaemia. India, Pakistan, and Ira are seeing a large increase in thalassaemia patients. Pakistan alone has 250,000 such patients. These patien require blood transfusions for life-time.

International Thalassaemia Day:

The world celebrates the International Thalassaemia Day on 8th of May. This day is dedicated to rai public awareness about thalassaemia and to highlight the importance of the care for thalassaemia patients.

Q. No. 10 Write a note on ABO blood group system.

ABO BLOOD GROUP SYSTEM

Introduction:

It is the most important blood group system in humans.

Discovery:

It was discovered by the Austrian scientist Karl Landsteiner, who found four different blood groups (blood types) in 1900. He was awarded Nobel Prize in Medicine for his work.

Basis:

In this system, there are four different blood groups which are distinct from each other on the basis of specific antigens (antigen A and B) present on the surface of RBCs.

1. **Blood group A:** A person having antigen A has blood group A.
2. **Blood group B:** A person having antigen B has blood group B.
3. **Blood group AB:** A person having both antigens A and B has blood group AB.
4. **Blood group O:** A person having none of the antigens A and B has blood group O.

Antibodies Present:

After birth, two types of antibodies i.e. anti-A and anti-B antibodies appear in blood serum of individuals.

These antibodies are found according to the absence of corresponding antigen.

Blood group A: In persons with blood group A, antigen A is present, so their blood will contain anti-B antibodies.

Blood group B: In persons with blood group B, antigen B is present, so their blood will contain no antibody.

Blood group AB: In persons with blood group AB, antigens A and B are present, so their blood will contain anti-B antibodies.

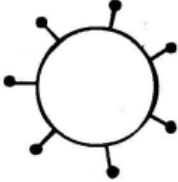
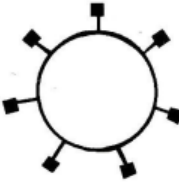
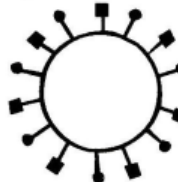
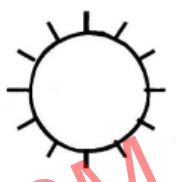
Blood group O: In persons with blood group O, neither antigen A nor antigen B is present. So their blood will contain both antibodies i.e. anti-A and anti-B.

	Blood Group A	Blood Group B	Blood Group AB	Blood Group O
Red Blood Cells				
Antigens on RBCs	Antigen A	Antigen B	Antigen A&B	None
Antibodies in Serum	Anti-B	Anti-A	None	Anti-A & Anti-B

Figure: Presence and Absence of Antigens and Antibodies in ABO Blood Group System

Q. No. 11 Describe blood transfusion in ABO blood group system.

BLOOD TRANSFUSIONS IN ABO BLOOD GROUP SYSTEM

Definition:

The process of transferring blood or blood-based products from one person into the circulatory system of another person is called blood transfusion.

Advantages:

Blood transfusions can be life-saving in some situations such as: -

- Massive blood loss due to injury
- Blood lost during surgery
- Anaemia
- Haemophilia
- Thalassaemia
- Sickle-cell disease

Agglutination:

The clumping of red blood cells in cases of mismatched blood groups is called agglutination.

Discovery:

In 1930's, Karl Landsteiner discovered Rh Blood group system.

Rh Factors:

These are the antigens present on the surface of RBCs, and blood groups are distinctly different from one another due to the presence or absence of them.

Discovery of Rh Factors:

These factors were first discovered in Rhesus monkey, present on the surface of RBCs.

Types of Blood groups

In this system, there are two blood groups:

i. Rh-positive
ii. Rh-negative

i. Rh-positive Blood Group:

A person having Rh factors has blood group Rh-positive.

ii. Rh-negative Blood Group:

A person without Rh factors has blood group Rh-negative. An Rh-negative person does not produce Anti-Rh antibodies unless Rh-factor enters in his/her blood.

Blood Transfusions in Rh Blood Group System:

Transfusions of Rh-positive Blood Group:
Rh-positive blood group can be transfused to Rh-positive recipient because recipient's blood already has Rh-antigens and will not produce Anti-Rh antibody.
Transfusions of Rh-negative Blood Group:
Rh-negative blood group can be transfused to Rh-negative because donor's blood does not have Rh-antigen and so the recipient's blood will not produce Anti-Rh antibody.

- If an Rh-negative person receives Rh-positive blood, he/she will produce anti-Rh antibodies against Rh-factors.
- Rh-negative blood can be transfused to an Rh-positive recipient, only if donor's blood (Rh-negative) has never been exposed to Rh-antigens, and does not contain any anti-Rh antibody.

Q. No. 13 Write a note on human heart.

HUMAN HEART

Cardiac:

The term 'Cardiac' means 'related to the heart'.

Muscular Organ:

The heart is a muscular organ responsible for pumping blood through blood vessels by repeated contractions.

Location:

In human body, the heart is situated between lungs, in the middle of chest cavity (thorax), under breast bone.

STRUCTURE OF HUMAN HEART

Pericardium:

The heart is enclosed in a sac known as pericardium.

Pericardial Fluid:

There is a fluid between the pericardium and heart walls, called pericardial fluid.

Function: It reduces friction between the pericardium and the heart during heart contractions.

Cardiac Muscles:

The bulk of the walls of heart chambers is made up of cardiac muscles.

Cardiac Chambers:

Human heart consists of 4 chambers, like the heart of birds and other mammals.

- Two atria
- Two ventricles

Atria:

The upper thin-walled chambers are called left and right atria. The singular of atria is atrium.

Ventricles:

The lower thick-walled chambers are called left and right ventricles. The left ventricle is the largest and strongest chamber of the heart.

WORKING OF HUMAN HEART

Double Pump:

Human heart works as a double-pump. It receives deoxygenated (with less oxygen) blood from body and pumps it to the lungs. At the same time, it receives oxygenated (with more oxygen) blood from lungs and pumps it to all the body.

Separation of Blood:

Inside heart chambers, the deoxygenated and oxygenated bloods are kept separated.

Blood to Right Atrium:

The right atrium receives deoxygenated blood from body via the main veins, i.e.: the superior and inferior vena cavae.

Contraction of Right Atrium:

When the right atrium contracts, it passes the deoxygenated blood to the right ventricle.

Tricuspid Valve:

The opening between right atrium and right ventricle is guarded by a valve known as tricuspid valve (because it has three flaps). Tricuspid valve prevents the backflow of blood from right ventricle to right atrium.

Contraction of Right Ventricle:

When right ventricle contracts, the blood is passed to the pulmonary trunk, which carries blood to the lungs.

Pulmonary Semilunar Valve:

Location: This valve is present at the base of pulmonary trunk.

Function: It prevents the backflow of blood from the pulmonary trunk to the right ventricle.

Blood to Left Atrium:

The oxygenated blood from the lungs is brought by pulmonary veins to left atrium.

Contraction of Left Atrium:

Left atrium contracts and pumps this blood to left ventricle.

Bicuspid Valve:

The opening between left atrium and left ventricle is guarded by a valve known as bicuspid valve (because it has two flaps).

Contraction of Left Vntricle:

When left ventricle contracts, it pumps the oxygenated blood in aorta, which carries blood to all parts of body, except lungs.

Aortic Semilunar Valve:

Location: This valve is present at the base of aorta.

Function: It prevents the backflow of blood from aorta to the left ventricle.

Simultaneous Contraction:

Both atria are filled simultaneously. They contract together to pump the blood to both the ventricles. Similarly, both ventricles contract simultaneously to pump blood out of the heart.

Q. No. 14 Write a note on pulmonary and systemic circulation.

Action of Right and left sides of Heart:

Right side of heart collects deoxygenated blood from body and distributes it to lungs while left side collects oxygenated blood from lungs and distributes it to the body.

PULMONARY CIRCULATION

Definition:

The pathway on which deoxygenated blood is carried from heart to lungs and in return oxygenated blood is carried from lungs to heart is called pulmonary circulation or circuit.

Proper Gaseous Exchange:

The blood in pulmonary circulation is at lower pressure than the blood in systemic circulation. It gives sufficient time to blood for gaseous exchange in lungs.

SYSTEMIC CIRCULATION

Definition:

The pathway on which oxygenated blood is carried from heart to body tissues and in return deoxygenated blood is carried from body tissues to heart is called systemic circulation or circuit.

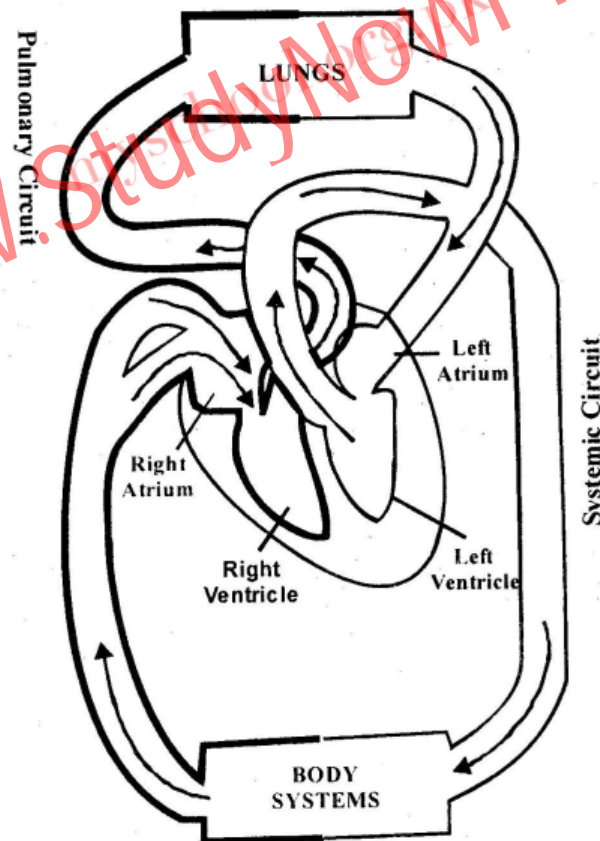



Figure: Double Circuit Circulation of Blood

Q. No. 15 Write a note on heartbeat.

HEARTBEAT

Definition:

The alternating contractions and relaxations make up the cardiac cycle and one complete cardiac cycle makes one heartbeat.

- The relaxation of heart chambers fills them with blood and contraction of chambers propels blood out of them.

Steps:

The complete cardiac cycle consists of the following steps:

i. **Cardiac Diastole:**
This is the first phase in which the atria and ventricles relax and blood is filled in atria.

ii. **Atrial Systole:**
Immediately after filling, both atria contract and pump the blood towards ventricles. This period in cardiac cycle is called atrial systole.

iii. **Ventricular Systole:**
Now, both ventricles contract and pump the blood towards body and lungs. The period of ventricular contraction is called ventricular systole.

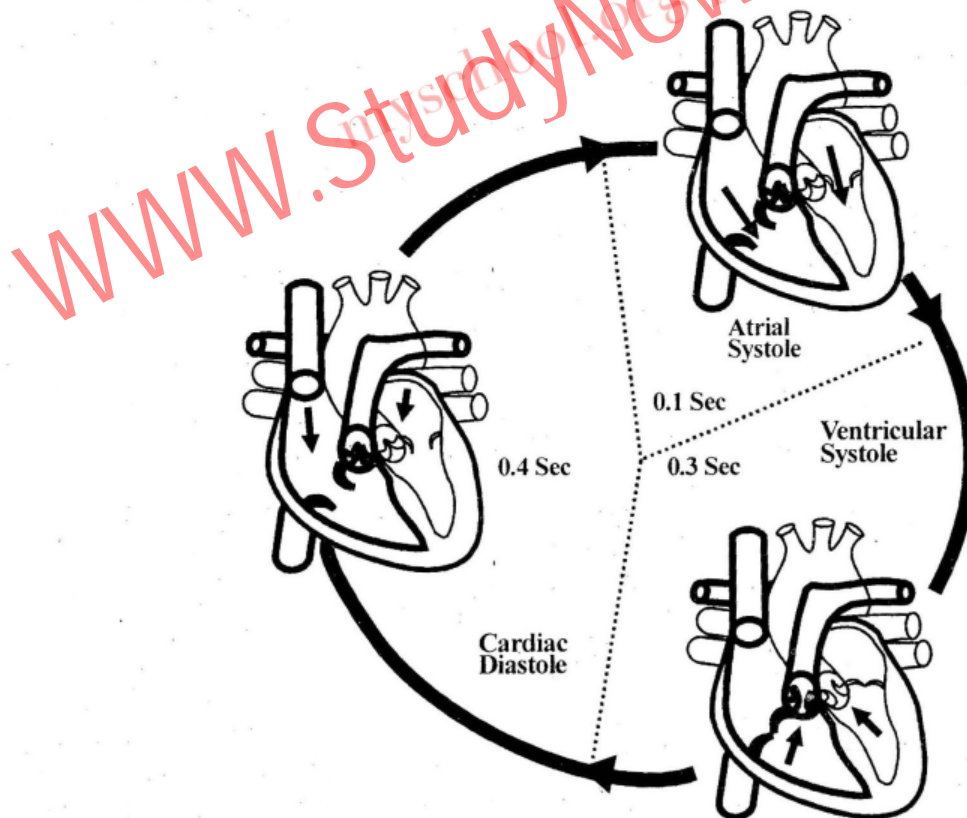



Figure: One Cardiac Cycle

Duration of Cardiac Cycle:

Total duration of one cardiac cycle is about 0.8 second, out of which

- Cardiac Diastole lasts for about 0.4 second
- Atrial Systole lasts for about 0.1 second
- Ventricular Systole lasts for about 0.3 second

'Lubb-dubb' Sound:

- When ventricles contract, the tricuspid and bicuspid valves close and produce the sound 'Lubb'
- When ventricles relax, the semilunar valves close and produce the sound 'Dubb'.

Hearing:

The 'Lubb-Dubb' sound can be heard with the help of a stethoscope.

Q. No. 16 Write a note on heart rate and pulse rate.

HEART RATE

Definition:

The number of times a heart beats per minute is called heart rate.

Normal Heart Rate:

At rest or during normal activities, the heart rate is 70 times per minute in men and 75 times per minute in women.

Fluctuations:

The heart rate fluctuates a lot depending on factors such as:

- Activity level
- Stress level

Measurement:

Heart rate can be measured by feeling the pulse.

PULSE RATE

Definition:

The rhythmic expansion and contraction of an artery as blood is forced through it by the regular contractions of the heart is called pulse.

Feeling of Pulse:

Pulse can be felt in the areas where an artery is close to the skin.

Examples:

- Wrist
- Neck
- Groin
- Top of the foot

Figure: Method of Taking Pulse

Measurement:

Most commonly, people measure their pulse in their wrist.

Q. No. 17 Write a note on blood vessels.

BLOOD VESSELS

Introduction:

The third part of blood circulatory system is the blood vessels.

Function:

They transport blood throughout the body.

Types:

The most important blood vessels in the system are:

- Arteries
- Veins
- Capillaries

ARTERIES

Definition:

The blood vessels which carry blood away from the heart are called arteries.

Blood Type:

In adults, all arteries carry oxygenated blood with the exception of pulmonary arteries that carry deoxygenated blood in them.

Structure:

The structure of arteries is well adapted to their function. The walls of an artery are composed of three layers:

- **The Outermost Layer:** It is made up of connective tissue.
- **The Middle Layer**: It is made up of smooth muscles and elastic tissue.
- **The Innermost Layer**: It is made up of endothelial cells.

Lumen:

The hollow internal cavity in which blood flows is called lumen.

Arterioles:

When arteries enter boy organs, they divide into smaller vessels known as arterioles.

Capillaries:

Arterioles enter tissues and divide into capillaries.

CAPILLARIES

Definition:

The smallest blood vessels present in the tissues are called capillaries.

Formation:

The capillaries are formed by the division of arterioles.

Structure:

The walls of the capillaries are composed of only a single layer of cells called endothelium.

Size:

Capillaries are so small that the red blood cells need to partially fold into bullet-like shapes in order to pass through them in a single file.

Function:

The exchange of materials between blood and tissue fluid is carried out through capillaries.

- The endothelium is so thin that molecules of digested food, oxygen, water etc. can pass through them and enter tissue fluid.
- Waste products such as carbon dioxide and urea can diffuse from the tissue fluid into blood.

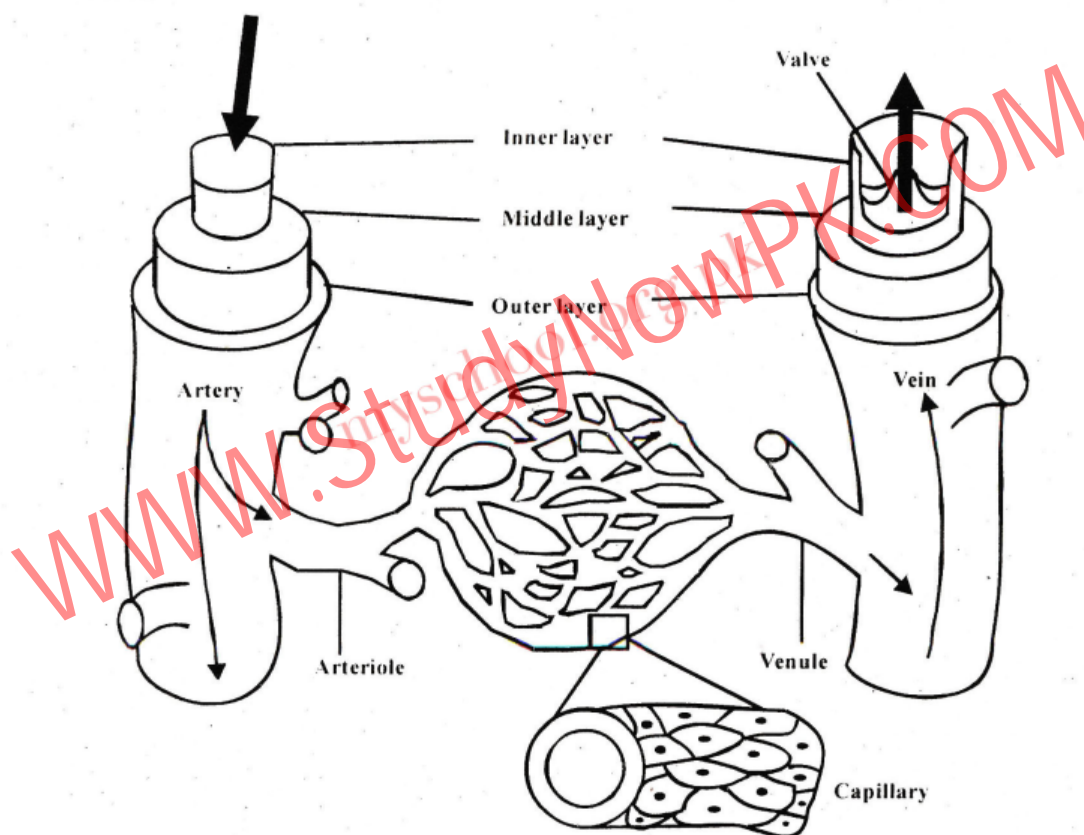



Figure: Blood Vessels

VEINS

Definition:

The blood vessels which carry blood towards the heart are called veins.

Blood Type:

In adults, all veins carry deoxygenated blood with the exception of pulmonary veins that carry oxygenated blood in them.

Structure:

The structure of a vein is also well-adapted to its function. The walls of a vein are composed of three layers as are present in an artery wall.

- **The Outermost Layer**: It is made up of connective tissue.
- **The Middle Layer**: It is made up of smooth muscles and elastic tissue.
- **The Innermost Layer**: It is made up of endothelial cells.

Difference from Arteries:

- The middle layer of the vein is comparatively thin.
- The lumen of the veins is broader than that of arteries.
- Most veins have flaps called valves that prevent the back flow of blood.

Formation of Venules:

In a tissue, the capillaries join to form small venules.

Formation of Vein:

All of the venules of an organ unite to form a vein.

Q. No. 18 Give a comparison of arteries, capillaries and veins.

COMPARISON OF ARTERIES, CAPILLARIES AND VEINS

Characteristics	Arteries	Capillaries	Veins
Function	Carry blood away from heart	Allow exchange of materials between blood and tissues	Carry blood towards heart
Thickness	Thick	One-cell thick	Thin
Elasticity in walls	Elastic	Non-elastic	less elastic
Muscles in walls	Thick	No muscles	Thin
Blood pressure	High BP	Medium BP	Low BP
Valves	No valves	No valves	Valves present

Q. No. 19 Write a note on arterial system of man.

THE ARTERIAL SYSTEM

Definition:

The system of arteries which carries blood from the heart to all body parts is called the arterial system.

Pulmonary Trunk:

Large pulmonary trunk emerges from right ventricle and divides into right and left pulmonary arteries, which carry de-oxygenated blood to right and left lungs.

Aorta:

The oxygenated blood leaving the left ventricle of heart is carried in a large artery, the aorta.

Aortic Arch:

The aorta ascends and forms an aortic arch. The arch curves left and descends inferiorly into the body.

From the upper surface of aortic arch, three branches emerge which supply blood to:

- Head
- Shoulders
- Arms

Dorsal Aorta:

As the aorta passes down through thorax, it becomes dorsal aorta. It gives off many branches and the important ones are listed here:

1. **Intercostal Arteries:**

   Several intercostal arteries supply blood to ribs.

2. **Celiac artery and Superior Mesenteric Artery:**

   Supply blood to the digestive tract.

3. **Hepatic Artery:**

   Supplies blood to the liver.

4. **Renal Arteries:**

   A pair of renal arteries supplies blood to kidneys.

5. **Gonadal Arteries:**

   These supply blood to gonads.

6. **Inferior Mesenteric Artery:**

   Just below the gonadal arteries, is inferior mesenteric artery supplies blood to a part of large intestine and rectum.

7. **Iliac Arteries:**

   The aorta divides into two common iliac arteries, each of which divides into an:

   - Internal iliac artery
   - External iliac artery

   Femoral Artery:

   Each external iliac artery becomes femoral artery in the upper thigh. It gives branches to the thigh, knee, shank, ankle, and foot.

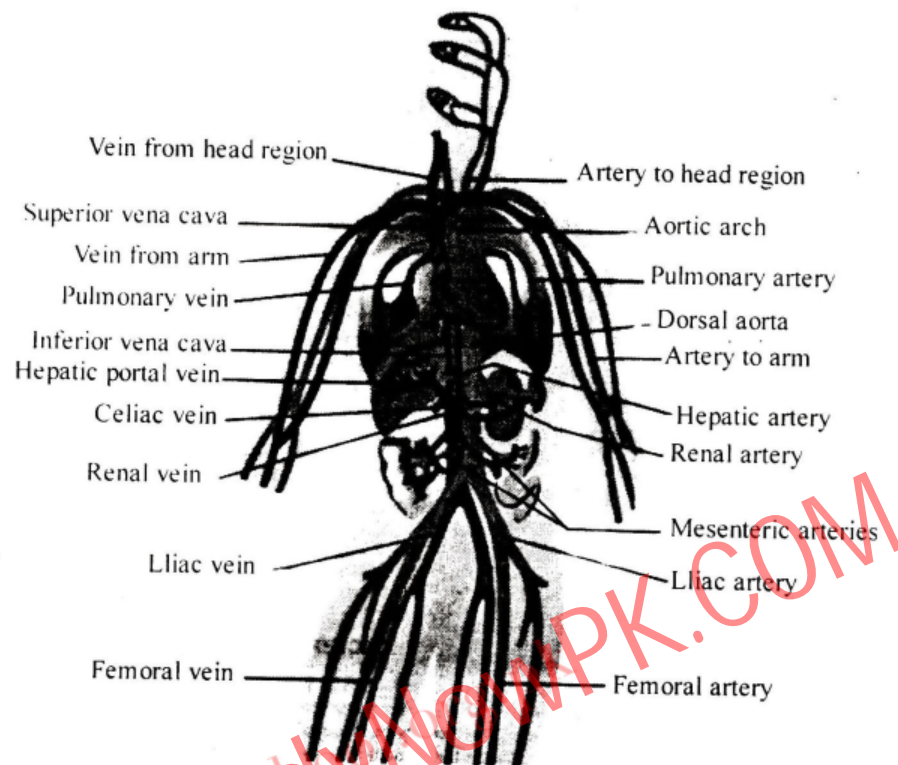



Figure: Major Arteries and Veins in Human Body

Q. No. 20 Write a note on venous system of man.

THE VENOUS SYSTEM

Definition:

The system of veins which carries blood from different parts of body to the heart is called venous system.

Pulmonary Veins:

Veins from lungs, called pulmonary veins return the oxygenated blood to the left atrium of the heart.

Major Veins:

Two major veins carrying deoxygenated blood from rest of the body, empty into the right atrium. These are:

i. Superior Vena Cava
ii. Inferior Vena Cava

Formation of Superior Vena Cava:

Superior vena cava forms when different veins join together from:

- Head
- Shoulders
- Arms

Formation of Inferior Vena Cava:

Inferior vena cava is formed by many veins which bring deoxygenated blood from the legs and lower region of body.

The following veins join to form inferior vena cava:

1. **Femoral Vein:**
   The veins carrying blood from the following regions of our body join together to form femoral vein:
   - Calf
   - Foot
   - Knee
2. **Common Iliac Vein:**
   The femoral vein empties into the external iliac vein, which joins the internal iliac vein, and then both empty into the common iliac vein. The right and left common iliac veins join to form the inferior vena cava.
3. **Hepatic Vein:**
   Carries blood from liver and empties into inferior vena cava.
4. **Renal Veins:**
   Two renal veins carry blood from kidneys and empty into inferior vena cava.
5. **Gonadal Veins:**
   Two gonadal veins carry blood from gonads and empty into inferior vena cava.
6. **Hepatic Portal Vein:**
   All veins coming from the following organs drain into hepatic portal vein, which carries this blood to the liver:
   - Stomach
   - Spleen
   - Pancreas
   - Intestine
7. **Hepatic Vein:**
   Hepatic carries blood from liver and empties into inferior vena cava.
8. **Thoracic Veins:**
   In the thoracic cavity, inferior vena cava also receives veins from thoracic walls and ribs.

Q. No. 21 Write a note on cardiovascular disorders.

CARDIOVASCULAR DISORDERS

Definition:

The diseases which involve the heart or blood vessels are collectively called cardiovascular disorders.

- These diseases have similar causes, mechanisms, and treatments.

Risk Factors:

The risk factors that lead to cardiovascular disorders include:

- Advanced age
- Diabetes
- High blood concentration of low-density lipids e.g. cholesterol and triglycerides

- High blood pressure (Hypertension)
- Tobacco smoking
- Obesity
- Sedentary life style
- Family history

Major Cause of Non-accidental Deaths:

It has been estimated that cardiovascular disorders are the major cause of sudden non-accidental deaths in developed as well as developing countries.

ATHEROSCLEROSIS

Introduction:

It is a chronic disease. It is commonly referred to as 'narrowing' of the arteries.

Causes:

It characterized by the accumulation of the following in the lumen of the arteries:

- Fatty materials
- Cholesterol
- Fibrin

Prime Contributor:

The accumulation of cholesterol is the prime contributor to atherosclerosis.

Severe Condition:

When this condition is severe, arteries can no longer expand and contract properly and blood moves through them with difficulty.

Atherosclerotic Plaques:

The accumulation of cholesterol results in the formation of multiple deposits called plaques within arteries.

Thrombus:

The plaques can form blood clots called thrombus within arteries.

Embolus:

If a thrombus dislodges and becomes free-floating, it is called an embolus.

ARTERIOSCLEROSIS

Introduction:

Arteriosclerosis is a general term describing any hardening of arteries.

Cause:

It occurs when calcium is deposited in the walls of arteries. It can happen when atherosclerosis is severe.

MYOCARDIAL INFARCTION

Introduction:

It is a medical emergency, and a leading cause of death for men and women all over the world.

Common Name:

It is more commonly known as heart attack.

Meaning:

The term myocardial infarction is derived from:

- **Myocardium:** The heart muscle
- **Infarction:** Tissue death

Silent Myocardial Infarctions:

Approximately one fourth of all myocardial infarctions are silent i.e., without chest pain or other symptoms. A silent heart attack is more common in the elderly, in patients with diabetes mellitus and after heart transplantation.

Causes:

It occurs when:

- There is blood clot in coronary arteries
- Blood supply to a part of the heart is interrupted and leads to the death of heart muscles

Symptoms:

- Severe chest pain is the most common symptom.
- Sensation of tightness, pressure, or squeezing in chest.
- Pain radiates most often to left arm
- Pain may also radiate to the lower jaw, neck, right arm and back
- Loss of consciousness
- Sudden death may occur

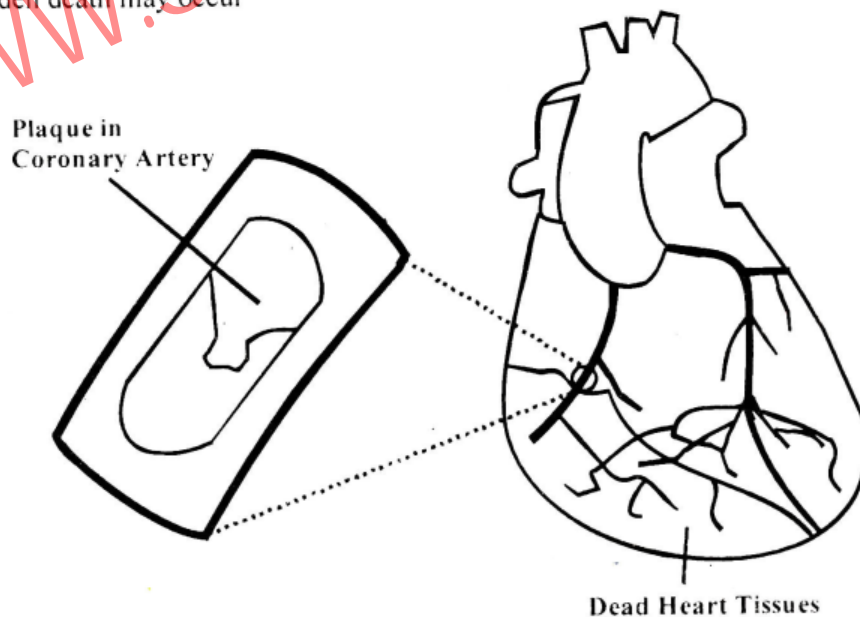



Figure: Atherosclerosis and resulting Myocardial Infarction

Treatment:

Immediate Treatment:

Immediate treatment for a suspected acute myocardial infarction includes:

- Oxygen supply
- Aspirin
- Sublingual tablet of glyceryl trinitrate
- Surgical methods (Angioplasty or By-pass Surgery)

Angioplasty:

The mechanical widening of a narrowed or totally obstructed blood vessel is called angioplasty. Most cases of myocardial infarction are treated by angioplasty.

Bypass Surgery:

It is a surgery in which arteries or veins from elsewhere in a patient's body are grafted into the coronary arteries to improve blood supply to heart muscles.

World Heart Day:

World Heart Day is held on 28th September every year throughout the world. Its objective is to help people better understand their personal risks of cardiovascular disorders.

ANGINA PECTORIS

Meaning:

Angina pectoris means chest pain.

Symptoms:

The pain may occur in heart and often in left arm and shoulder.

Severity:

It is not as severe as heart attack.

Warning Sign of Heart Attack:

It is a warning sign that blood supply to heart muscles is not sufficient but shortage is not enough to cause tissue death.

Q. No. 22 What is coronary circulation?

CORONARY CIRCULATION

Need:

Even though the heart chambers are continually bathed with blood, this does not nourish heart muscles.

Definition:

Coronary arteries and veins are collectively called coronary circulation and it is a part of systemic circulation.

Coronary Arteries:

The blood supply to the heart muscles is provided by coronary arteries which emerge from the base of aorta.

Coronary Veins:

Heart muscles are drained by coronary veins which empty into right atrium.

REVIEW QUESTIONS

MULTIPLE CHOICE

1. **In most plants, food is transported in the form of:**
   (a) Glucose (b) Sucrose (c) Starch (d) Proteins
2. **Stomata close when guard cells:**
   (a) Lose water (b) Gain chloride ions
   (c) Become turgid (d) Gain potassium ions
3. **Trace the pathway of water from soil through the plant to atmosphere:**
   (a) Endodermis, cortex, epidermis, xylem, intercellular spaces in mesophyll, stomata
   (b) Epidermis, endodermis, phloem, cortex of leaf, intercellular spaces of mesophyll, stomata
   (c) Root hairs, epidermis, cortex, xylem, endodermis, intercellular spaces in mesophyll, stomata
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4. **When fibrinogen makes blood clot, it separates from blood and the remainder is called:**
   (a) Plasma (b) Lymph
   (c) Serum (d) Pus
5. **What is correct about human red blood cells?**
   (a) Have limited life span (b) Are capable of phagocytosis
   (c) Produce antibodies (d) Are multinucleate
6. **Which of the following tissue layer is found in all blood vessels?**
   (a) Smooth muscle (b) Endothelium
   (c) Skeletal muscle (d) Connective tissue
7. **When do the atria contract?**
   (a) Before diastole (b) After systole
   (c) During diastole (d) During systole
8. **Which of the following contains deoxygenated blood in an adult human?**
   (a) Left atrium (b) Pulmonary artery
   (c) Pulmonary vein (d) All of the above
9. **Which of the following chambers has the thickest walls in human heart?**
   (a) Right atrium (b) Left atrium
   (c) Left ventricle (d) Right ventricle
10. **Which of these statements is correct about circulatory system?**
    (a) It transports hormones
    (b) Capillaries have thicker walls than veins
    (c) Systemic circulation carries blood to and from the lungs
    (d) All are true
11. **Exchange of materials between blood and surrounding tissues occurs in:**
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    (c) Capillaries (d) All of the above

12. **Which of the following is a type of leukocytes?**
(a) Lymphocyte (b) Eosinophil
(c) Monocyte (d) All of the above

13. **Which of the following is a function of human blood?**
(a) It regulates body temperature (b) It transports wastes
(c) It provides defense (d) All of the above

14. **Valves to prevent the backflow of blood are found in:**
(a) Arteries (b) Veins
(c) Capillaries (d) All of the above

15. **Plasma is made up of water and:**
(a) Metabolites and wastes (b) Salts and ions
(c) Proteins (d) All of the above

16. **Which of these are responsible for blood clotting?**
(a) Platelets (b) Erythrocytes
(c) Neutrophils (d) Basophils

17. **Find the correct path of blood circulation:**
(a) Left atrium, left ventricle, lungs, right atrium, right ventricle, body
(b) Right atrium, right ventricle, lungs, left atrium, left ventricle, body
(c) Left atrium, left ventricle, right atrium, right ventricle, lungs, body
(d) Right atrium, lungs, right ventricle, left atrium, body, left ventricle

18. **A patient with blood group A can be given the blood of donor who has:**
(a) Blood group A or AB (b) Blood group A or O
(c) Blood group A only (d) Blood group O only

19. **The death of heart tissue is called:**
(a) Atherosclerosis (b) Arteriosclerosis
(c) Myocardial infarction (d) Thalassaemia

20. **What happens when a mismatched blood is injected in a recipient?**
(a) Antibodies of recipient's blood destroy donor's RBCs
(b) Antibodies of donor's blood breakdown recipient's RBCs
(c) Both of these can happen
(d) None of these happen and such transfusion can be safe

ANSWERS:

1	b	2	a	3	d	4	c	5	a
6	b	7	d	8	b	9	c	10	a
11	c	12	d	13	d	14	b	15	d
16	a	17	b	18	b	19	c	20	a

UNDERSTANDING THE CONCEPTS

(1) *How would you relate the internal structure of root with the uptake of water and salts?*

Consult Long Question No. 1

(2) Define transpiration and relate it with cell surface and with stomatal opening and closing.

Consult Long Questions No. 2, 3 & 4

(3) How do different factors affect the rate of transpiration?

Consult Long Question No. 4

(4) Transpiration is a necessary evil. Give comments.

Consult Long Question No. 5

(5) Explain the movement of water in terms of transpirational pull.

Consult Long Question No. 6

(6) Describe the theory of pressure flow mechanism to explain the translocation of food in plants.

Consult Long Question No. 7

(7) List the functions of the components of blood.

Consult Long Question No. 8

(8) How do we classify blood groups in terms of ABO and Rh blood group systems?

Consult Long Question No. 10

(9) State the signs and symptoms, causes and treatments of leukemia and thalassaemia.

Consult Long Question No. 9

(10) What four chambers make the human heart and how does blood flow through these chambers?

Consult Long Question No. 13

(11) Compare the structure and function of an artery, a vein, and a capillary.

COMPARISION OF ARTERIES, VEINS AND CAPILLARIES

Characteristics	Arteries	Veins	Capillaries
Function	Carry blood away from the heart	Carry blood towards the heart	Allow exchange of materials
Thickness	Thick	Thin	One-cell thick
Elasticity	Elastic	Less elastic	Non elastic
Muscles	Thick	Thin	None
Blood pressure	High	Low	Medium
Valves	Absent	Present	Absent
Type of blood	Oxygenated, (exception: Pulmonary artery)	De-oxygenated (exception: Pulmonary vein)	Can carry both as they connect arterioles & venules

(12) Draw diagrams which can illustrate the origins, locations, and target areas of the main arteries in human blood circulatory system.

Consult Figure of Long Question No. 19

(13) Draw diagrams which illustrate the areas and locations of the main veins in human blood circulatory system.

Consult Figure of Long Question No. 19

(14) How would you differentiate between atherosclerosis and arteriosclerosis?

DIFFERENCE BETWEEN ATHEROSCLEROSIS AND ARTERIOSCLEROSIS.

Feature	Atherosclerosis	Arteriosclerosis
Main pathology	Narrowing of arteries	Hardening of arteries
Cause	Deposits *on* the artery walls	Deposits *in* the artery walls
Agents	Cholesterol, fibrin, dead cells	Calcium deposits
Plaques/deposits	Deposits form atherosclerotic plaques	Deposits usually do not form plaques
Thrombus formation	Accumulated plaques give rise to atherosclerotic masses called thrombi which can partially or completely occlude an artery lumen.	No characteristic thrombus formation, but lumen obliteration may be present.
Relationship with each other	It involves arteriosclerosis in advanced stages.	It is a form of atherosclerosis in advanced stage.

(15) State the causes, treatments and prevention of myocardial infarction.

Consult Long Question No. 21

SHORT QUESTIONS

(1) What are lenticels and where are they found in plant body?

LENTICELS

A **lenticel** is an airy aggregation of cells within the structural surfaces of the stems, roots, and other parts of vascular plants, especially woody plants.

Function:

It functions as a pore, providing a medium for the direct exchange of gasses between the internal tissues and atmosphere

Location:

These special openings are found on the stems of some vascular plants, where they allow gaseous exchange.

(2) What is the role of potassium ions in the opening of stomata?

OPENING OF STOMATA BY K^+ IONS INFLUX

Recent studies have shown that stomata actually open and close due to the movement of potassium ions in and out of guard cells.

Blue wavelengths of daylight open stomata by allowing K^+ to flow into the guard cells from the surrounding epidermal cells. Water passively flows these ions into guard cells, and stomata open as their turgidity increases.

(3) **Define the cohesion-tension theory.**

COHESION-TENSION THEORY

According to this theory, the mechanism by which water (along with dissolved *materials) is carried upward through the xylem is transpirational-pull.* Transpiration creates a pressure difference that pulls water and salts up from the roots.

(4) **What do you mean by sources and sinks according to the pressure-flow mechanism?**

SOURCES

Sources are exporting organs, such as:

- A mature leaf
- A storage organ

SINKS

Sinks are areas of active metabolism or storage, such as:

- Roots
- Tubers
- Developing fruits and leaves
- Growing regions

Organ working as Both Source and Sink:

A storage organ is capable of storing food and exporting stored materials. The root of beet is a sink in first growing season. It becomes source in the next growing season, when sugars are utilized in the growing of new shoots.

(5) **What are the two main types of white blood cells? How do they differ?**

TYPES OF WHITE BLOOD CELLS

- **Granulocytes**
- **Agranulocytes**

Feature	Granulocytes	Agranulocytes
Cell features	Granular cytoplasm	Clear cytoplasm
Cytoplasmic granules	Present, visible on staining	Absent
Formation	Red bone-marrow	Lymphoid tissue
Nucleus	Multi-lobed	Single
Types	Eosinophils, basophils, neutrophils	Monocytes, Lymphocytes
Functions	**Eosinophils:** Kill parasites Break inflammatory substances **Basophils:** Prevent blood clotting **Neutrophils:** Destroy small particles by phagocytosis	**Monocytes:** Produce macrophages which engulf germs **Lymphocytes:** Produce antibodies and kill germs

(6) You see pus at the site of an infection on your skin. How is it formed?

PUS

Pus is a thick yellowish liquid produced in an infected tissue, consisting of dead white blood cells, bacteria, tissue debris, and serum.

FORMATION OF PUS

White blood cells die in the process of killing the germs. These dead cells accumulate & make the white substance called pus seen at the infection site.

(7) What role does the pericardial fluid play?

PERI-CARDIAL FLUID

The fluid between the pericardium and heart walls is called 'pericardial fluid'.

Role:

The presence of this fluid reduces friction between the pericardium and the heart walls during heart contractions

(8) Define the terms Systole and Diastole.

SYSTOLE

The period of rhythmic contraction of the heart is called systole. It is of two types:

i. **Atrial Systole:** The phase in which both atria contract and pump the blood towards ventricles

ii. **Ventricular Systole:** The phase in which both ventricles contract and pump the blood towards body and lungs.

DIASTOLE

The phase in which the atria and ventricles relax and blood is filled in atria is called diastole.

THE TERMS TO KNOW

ABO system: A system of classifying various types of blood, based on the presence of specific antigens A, B, both, or none on the surface of RBCs. It was discovered by Karl Landsteiner.

Agglutination: Clumping of Red blood cells in cases of mismatched blood groups

Agranulocytes: The leukocytes with a clear cytoplasm, formed in lymphoid tissue. Monocytes and lymphocytes are agranulocytes.

Albumin: A plasma protein which helps to maintain the water balance of blood.

Angina pectoris: Chest pain occurring due to ischemia (lack of blood supply) to myocardial muscles.

Anti-A antibody: An antibody found in individuals with blood group B.

Anti-B antibody: An antibody found in individuals with blood group A.

Antigen: A substance which stimulates the production of an antibody when introduced into the body, i.e it can stimulate an immune response.

Antigen A: An antigen found in individuals with blood group A.

Antigen B: An antigen found in individuals with blood group B.

Anti-Rh antibody: An antibody found in individuals who are exposed to Rh antigens.

Aorta: The main artery supplying oxygenated blood to the body.

Aortic arch: The part of aorta which curves and descends downwards

Arteriole: A small branch/division of an artery leading into capillaries

Arteriosclerosis: the hardening of arteries due to calcium deposition in the walls

Artery: A blood vessel carrying blood away from the heart, usually carrying oxygenated blood (exception: Pulmonary artery)

Atherosclerosis: Narrowing of arteries usually due to lipid deposition and formation of atherosclerotic plaques.

Atrial systole: The phase in which atria contract and push blood towards ventricles.

Atrium: One of the two upper chambers of the heart.

B lymphocyte: WBCs which produce antibodies

Basophils: WBCs which stain blue, and are involved in the production of Heparin and Histamine.

Bicuspid valve: A valve present between left atrium and left ventricle, consisting of two flaps, to prevent the backflow of blood to the left atrium.

Blood group systems: Classification systems for human blood, 29 in number.

Capillary: The smallest blood vessels, allowing exchange of materials between blood and tissues.

Cardiac cycle: A sequence of events which occur in one heart beat.

Cardiovascular system: An organ system responsible for the passage of nutrients, hormones, gases etc. to and from cells.

Cohesion-tension theory: According to this theory, the mechanism by which water (along with dissolved materials) is carried upward through the xylem is transpirational-pull

Coronary artery: A blood vessel supplying oxygenated blood to the heart muscles.

Cortex: A wide zone of large, thin-walled cells seen in cross section of a plant root.

Diastole: The phase in which atria and ventricles relax and blood is filled in atria.

Dorsal aorta: As the aorta passes down the thorax, it become dorsal aorta and supplies blood to the viscera below thorax

Embolus: A dislodged thrombus which becomes freely floating in blood stream.

Endodermis: A single layer of cells around the pericycle, seen in cross section of a plant root.

Eosinophils: A type of WBCs which stains pink, and function in defense against parasites, and break inflammatory substances.

Erythrocytes: Red blood cells, which are bi-concave in shape and contain hemoglobin. They carry oxygen and small amounts of carbon dioxide.

Fibrin: A plasma protein involved in blood clotting

Fibrinogen: A protein synthesized by the liver, which is converted into fibrin during blood coagulation.

Granulocytes: White blood cells with a granular cytoplasm, formed in the red bone-marrow. They are Eosinophils, Basophils, and Neutrophils

Guard cell: A specialized kidney-shaped cell found in the leaf epidermis. Pairs of guard cells surround stomatal openings.

Hemoglobin: The iron-containing protein present in red blood cells which carries oxygen.

Heart rate: The number of times a heart beats per minute.

Lenticels: Special airy aggregations of cells within the structural surfaces of the stems, roots, and other parts of vascular plants, especially woody plants. Function as a pore, providing a medium for the direct exchange of gasses between the internal tissues and atmosphere

Leucocytes: White blood cells. Defense cells of the body.

Leukemia: A disease characterized by production of a great number of immature and abnormal white blood cells.

Lymphocytes: A type of agranular white blood cells, which produce antibodies.

Lymphogenous cells: Cells which give rise to agranular WBCs.

Megakaryocytes: The bone-marrow cells responsible for the production of platelets.

Monocytes: A type of agranular white blood cells, which turn into resident macrophages and engulf germs.

Myocardial infarction: The death of heart musculature, resulting from anoxia. Also known as Heart Attack.

Neutrophils: A type of granular white blood cells, which destroy small particles like bacteria by phagocytosis.

Pericardial fluid: A fluid present between pericardium and heart muscles to reduce friction during beating of heart

Pericardium: A fluid-filled sac which encloses the heart

Pericycle: A narrow layer of thin-walled cells, surrounding the vascular tissues in a cross section of plant root.

Phloem: The tissue found in vascular plants, that carries organic nutrients to all plant parts.

Plasma: The yellow liquid component of blood in which blood cells are suspended. It makes up 55% of the total blood volume.

Platelets: Thrombocytes. Small, regularly shaped colorless fragments of large bone marrow cells called Megakaryocytes.

Pulmonary artery: A blood vessel carrying deoxygenated blood from the right ventricle to lungs.

Pulmonary circulation: The pathway of blood to and from the lungs

Pulmonary vein: The blood vessel carrying oxygenated blood from the lungs to the left atrium.

Pulse: The rhythmic contraction and relaxation of an artery as blood is forced through it by the regular contractions of the heart.

Red blood cells: Erythrocytes. Bi-concave, round disc-shaped cells which are the most abundant of all cells in blood, and contain Hemoglobin.

Rh factors: Specific antigens detected on the RBC surface in Rh blood group system.

Rh-blood group system: A blood group system which classifies blood as Rh-positive and Rh-negative according to the presence or absence of specific Rh-antigen on the surface of RBCs.

Root hair: Small extensions of epidermal cells which extend between the soil particles and function to increase the surface area for absorption of water and salts.

Semilunar valve: Half-moon shaped valves, which are located at the base of aorta and pulmonary trunk, to prevent the backflow of blood to the left and right ventricles respectively.

Stoma: The opening surrounded by a pair of guard-cells in epidermis through which gaseous exchange occurs.

Systemic circulation: The pathway of blood to and from the body parts.

T Lymphocytes: The type of agranular white blood cells which

Thalassaemia: *A hereditary disease characterized by defective hemoglobin, reduced* hemoglobin, or absent hemoglobin

Thrombocytes: Another name for platelets

Thrombus: A mass formed by atherosclerotic plaques, usually of lipids e.g. cholesterol deposits, which forms on the artery wall and partially or completely blocks it.

Transpiration: The evaporation of water molecules from the aerial parts (especially through leaves).

Transpirational pull: *The pulling force created by the transpiration of water in the form of a* continuous stream or column.

Tricuspid valve: A valve present between the right atrium and right ventricle, consisting of three flaps, to prevent the backflow of blood into the right atrium.

Vein: A type of blood vessel, which brings blood towards the heart. It usually carries de-oxygenated blood (exception: pulmonary vein).

Vena cava: One of the two major veins responsible for the collection of de-oxygenated blood from the body and bringing it to the right atrium.

Ventricle: One of the two lower chambers of the heart

Ventricular systole: A phase in which ventricles contract and push the blood towards body and lungs.

Venule: A branch of vein which is given off in tissues, and leads into a capillary.

White blood cells: Leukocytes. The type of blood cells involved in the defense mechanism of body

Wilting: The flaccidity (loss of turgidity) of non-woody parts of plant.

Xylem: A tissue found in the vascular plants, which is responsible for the conduction of water and salts from the roots to all parts of the body.

Pus: A thick, yellowish liquid found in an infected tissue, consisting of dead white blood cells, bacteria, tissue debris, and serum.

Serum: The part of blood plasma which remains after the fibrin has been separated from it.